sides $\alpha=0$, $\beta=0$, $\gamma=0$, $\delta=0$, and the *lengths* of the corresponding sides by a, b, c, and d. Let radius of circle be r. Then the equation of the line joining the middle points of the diagonals is $a\alpha-b\beta+c\gamma-d\delta=0\ldots.(1)$ (Cf. Salmon's *Conics*, page 54, Ex. 5).

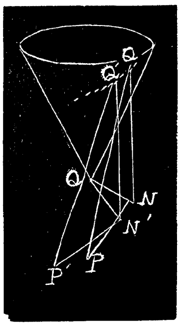
Putting $\alpha=\beta=\gamma=\delta=r$ we obtain $r(a-b+c-d)=0$, which is satisfied since $a+c=b+d$.

137. Proposed by J. W. YOUNG, Oliver Graduate Scholar in Mathematics, Cornell University, Ithaca, N. Y.

A right cone has its vertex in a horizontal plane, its axis being perpendicular to the plane. A string has one extremity attached to a point on the cone. The other extremity, P, of the string is kept in the plane, and the string is then wound around the cone, without being allowed to slip. Show that the spiral generated by P cuts all straight lines through the vertex at the same angle.

Solution by the PROPOSER.

Let P, P' be two points on the spiral; Q, Q' the corresponding points in the path of the string around the cone; N, N' the points where the perpendiculars from Q, Q' to the plane through the vertex O of the cone, cut the plane.



The right-angled triangles QNO, $Q'N'O$ have the angles QON and $Q'ON'$ equal; hence they are similar.

$$\therefore \frac{QN}{ON}=\frac{Q'N'}{ON'}\ldots.(1).$$

Again, since the string must not slip, it makes a constant angle with the plane.

$\therefore$ $\triangle QNP$ is similar to $\triangle Q'N'P'$.

$$\therefore \frac{PN}{QN}=\frac{P'N'}{Q'N'}\ldots.(2).$$

From (1) and (2),

$$\therefore \frac{PN}{ON}=\frac{P'N'}{ON'}\ldots.(3).$$

But the triangles ONP and $ON'P'$ are right-angled at N and N' (PN, $P'N'$ being the projections to tangents to the circular cone). From (3),

$\therefore$ $\triangle ONP$ is similar to $\triangle ON'P'$.

$\therefore$ $\measuredangle OPN=\measuredangle OP'N'$.

Observing that PN and $P'N'$ are normals to the spiral, the last equation states that the normals make a constant angle with rays through O. Q. E. D.

AVERAGE AND PROBABILITY.

90. Proposed by WALTER H. DRANE, Graduate Student, Harvard University, Cambridge, Mass.

During a heavy rain storm a circular pond is formed in a circular field. If a man undertakes to cross the field in the dark, what is the chance that he will walk into the pond? [From *Byerly's Integral Calculus*.]

I. Solution by B. F. FINKEL, A. M., M. Sc., Professor of Mathematics and Physics, Drury College, Springfield, Mo.

Let O be the center of the circular field, and R its radius; C the center of